20th and 21st Century Geodetic Measurements for Ice Sheet Monitoring and the Importance of a Holocene Rebound Signal

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The past decade has seen slow but sustained progress toward quantifying the mechanical and dynamical state of the lower mantle and an important feature is beginning to emerge. In particular, the relatively large plastic strength of the mantle above the D" layer has the important ramification that the observed non-tidal second degree time-varying gravity field coefficient $\dot{J}_2$ is driven dominantly by isostatic flow of the deep mantle in response to late-Pleistocene/Holocene deglaciation as suggested some 12 years ago by *Yoder et al.* **[1983]** and *Peltier [1983]*. For time-varying harmonic degrees 3 and higher the sensitivity to ice sheet balance increases proportionally. Consequently, laser ranging to high-altitude, low-drag satellites (Lageos I and II, Starlette, Ajisai, etc.) during the next decade could provide an important and independent determination of time variability of the present-day water-ice mass transport in the global environment.

GPS measurements in Antarctica and Greenland might also provide independent constraints on large-scale ice mass variability. Two studies that computed the crustal motion response of a viscoelastic Earth (one by *James and Ivins [1995]* and the other by *Wahr, Han and Trupin [1995], see* GRL April 15) indicate that the measured signals in Antarctica should be highly sensitive to past land-ocean exchanges. In fact, the largest vertical secular signal computed in the former models is caused by isostatic memory of late-Pleistocene/Holocene deglaciation in Antarctica. The Holocene history of the Ross Ice Shelf, and of the greater West Antarctic ice sheet, play a central role in interpreting the crustal motion signature that could be obtained from land-based GPS measurements.

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10. None

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